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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

344. Proposed by V. M. SPUNAR, Cleveland, Ohio.

Given $x^7-5x^2y^4=-1506$...(1), and $y^5-3xy=103$...(2); find the values of x and y.

Solution by E. B. ESCOTT, Ann Arbor, Mich.

Drawing the graphs of the two equations we see that the only real intersection is for x between -2 and -2.84, and y between 2.4 and 2.53.

A few trials give the values to a few decimals

$$x=-2.4168, \quad y=2.43359.$$

Also solved by the Proposer.

345. Proposed by E. B. ESCOTT, Professor of Mathematics, University of Michigan.

Solve the simultaneous equations:

$$x^3+y^2z+zw^2-xz^2-2wxy=a\ldots(1).$$
$$y^3+z^2w+wx^2-yw^2-2xyz=b\ldots(2).$$
$$z^3+w^2x+xy^2-zx^2-2yzw=c\ldots(3).$$
$$w^3+x^2y+yz^2-wy^2-2zwx=d\ldots(4).$$

Solution by the PROPOSER.

If we put the determinant

$$\begin{vmatrix} x & y & z & w \\ w & x & y & z \\ z & w & x & y \\ y & z & w & x \end{vmatrix}=D\ldots(5),$$

we see that the minors of the first row are the first members of the given equations. Therefore, the minors of x, y, z, w in the determinant, D, are equal to a, b, c, d. Therefore the determinant

$$\begin{vmatrix} a & -b & c & -d \\ -d & a & -b & c \\ c & -d & a & -b \\ -b & c & -d & a \end{vmatrix}\ldots(6),$$

is the reciprocal determinant of D and is therefore equal to D^3. Also by the properties of reciprocal determinants the minors of the first row in (6) with their proper signs are equal to corresponding terms of the first row in (5) multiplied by D^2, *i. e.*

$$\left.\begin{array}{r}\begin{vmatrix} a & -b & c \\ -d & a & -b \\ c & -d & a \end{vmatrix}=xD^2 \\ \\ -\begin{vmatrix} -d & -b & c \\ c & a & -b \\ -b & -d & a \end{vmatrix}=yD^2 \end{array}\right\}\ldots(7),$$

etc. Solving (7) we have. after making a few changes of sign,

$$x=\frac{\begin{vmatrix} a & b & c \\ d & a & b \\ c & d & a \end{vmatrix}}{\begin{vmatrix} a & b & c & d \\ d & a & b & c \\ c & d & a & b \\ b & c & d & a \end{vmatrix}^{\frac{2}{3}}=\triangle}.$$

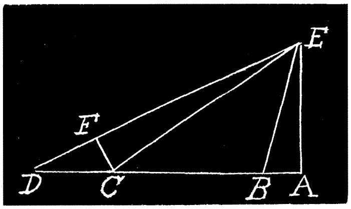
$$y=\frac{\begin{vmatrix} d & b & c \\ c & a & b \\ b & d & a \end{vmatrix}}{\triangle}\qquad z=\frac{\begin{vmatrix} d & a & c \\ c & d & b \\ b & c & a \end{vmatrix}}{\triangle}\qquad w=\frac{\begin{vmatrix} d & a & b \\ c & d & a \\ b & c & d \end{vmatrix}}{\triangle}$$

GEOMETRY.

372. Proposed by DANIEL KRETH, Oxford, Iowa.

In the right triangle ADE right angle A, are given: $AB=9$, $BC=280$, $CD=35$, angle AEB=angle CED; required the distance AE.

I. Solution by A. H. HOLMES, Brunswick, Me.



For $AB=9$, $BC=280$, and $CD=35$, the points B and C must be on the line AD. Otherwise the problem would be indeterminate. Let $AE=x$. Then $DE=\sqrt{(x^2+324^2)}$, $CE=\sqrt{(x^2+289^2)}$, and $BE=\sqrt{(x^2+9^2)}$.

From C let fall perpendicular CF to DE at F. To find EF we have

$$\sqrt{(x^2+324^2)} : \sqrt{(x^2+289^2)}+35=\sqrt{(x^2+289^2)}-35 : \frac{x^2+289^2-35^2}{\sqrt{(x^2+324^2)}}.$$